SUPPLEMENTAL SECTION B-2

AIR QUALITY ANALYSIS

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SUPPLEMENTAL SECTION B-2

SATSOP CT PROJECT PHASE II AIR QUALITY ANALYSIS

B-2.1 EXISTING CONDITIONS

B-2.1.1 Existing Air Emission Sources

Emissions of air pollutants from existing sources predominantly determine the air quality of the project vicinity. Air pollutants are emitted from a variety of existing sources in Grays Harbor County including point, area, and mobile sources. Point sources include facilities that generally emit pollutants from a single location. Area sources include operations ranging from dry cleaners and spray painting to woodstoves and outdoor burning. Mobile sources include motorized vehicles of all types. Motor vehicles account for over 50 percent of all air pollution nationwide and approximately 55 percent in Washington state.

Table B-2-1 shows 1999 annual emission inventory data of actual emissions for criteria pollutants of point sources in Grays Harbor County.

Table B-2-1
Grays Harbor County Air Emission Inventory
(Tons per Year Emitted)

Year	PM_{10}	SO_2	NO_2	CO	VOCs
1999	653	365	1,006	2,161	228

Source: Olympic Air Pollution Control Authority 2000 Annual Report, May 2001.

Major sources of air emissions are those greater than 100 tons per year of any criteria pollutant. Table B-2-2 shows the sources emitting greater than 100 tons of a criteria pollutant in one year which are located within 50 kilometers of the Satsop CT Project site.

Table B-2-2
Major Sources Near Satsop CT Project Site
(Tons per Year Emitted)

Facility	Location	TSP	PM_{10}	SO_2	NO_x	VOC	CO
Grays Harbor Paper LP	Hoquiam	268	137	29	271	12	749
Simpson Door Company	McCleary	140	86	1	20	12	28
Quality Veneer and Lumber Inc.	Hoquiam	35	28	1	13	9	917
Simpson Timber Company	Shelton	255	76	0	100	92	413
Crown Cork & Seal Company Inc.	Olympia	1	1	0	5	200	1
Weyerhaeuser Company	Cosmopolis	334	314	327	639	63	433
Boise Cascade Corporation	Elma	149	149	0	42	58	42

Source: Data presented are from the 1999 emission inventory as provided by the Department of Ecology, November 2001, for all facilities except Boise Cascade Corporation. Boise Cascade Corporation data provided by the Olympic Air Pollution Control Authority based on potential to emit values in the Notice of Construction Final Determination, March 2001.

B-2.1.2 Meteorology and Climate

The climate of western Washington is dominated by two large-scale influences: the mid-latitude westerly winds and proximity of the Pacific Ocean. Temperature data available from the National Climatic Data Center, measured over a 30 year period in Elma, indicate that monthly temperatures average 51ºF, with an average maximum of 67ºF, and an average minimum of 34ºF. Temperature extremes were recorded ranging from the high 20's for the minimum temperatures up to the high 90's as the maximum temperatures recorded. Few days below 32ºF are recorded for the project area. Meteorological data indicate that precipitation totals about 60 inches annually, with the wettest months from November to April. Approximately 5 inches of snow falls annually, primarily from December to March. Mean annual mixing heights for the morning hours are approximately 600 meters, while afternoon or evening hour mixing heights are approximately 1000 meters for the Northwest Pacific Coastal region. Relative humidity ranges from about 30 percent during the summer months, and winter months average about 60 percent.

Representative meteorological data for the project site and vicinity was obtained from a meteorological monitoring station located within the Satsop Power Plant boundary. Additional meteorological parameters were obtained from Olympia and Seattle-Tacoma International Airport National Weather Service stations. The data indicate a predominant east and east-northeast wind direction. Calm periods were recorded for 1.5 percent of the collection period.

Wind speeds averaged 3.0 meters per second (m/s), with the strongest winds 5-7 m/s from the east. Westerly winds were also recorded with milder wind speeds of 3-5 m/s. An annual wind rose is presented in Figure B-2-1.

B-2.1.3 Existing Air Quality

The State and National Ambient Air Quality Standards limit the concentrations of air pollution that is permissible in all air basins. These regulations govern six pollutants known as criteria pollutants. Each criteria pollutant has primary and secondary standards. Primary standards define air quality levels judged necessary to protect public health with a margin of safety while secondary standards protect public welfare from any known or anticipated adverse effects associated with these pollutants. Grays Harbor County, where the project area is located, is governed by the Olympic Air Pollution Control Authority (OAPCA). Grays Harbor County has had no demonstrated violations of air quality standards and therefore areas adjacent to the project site are currently designated as being in attainment with ambient air quality standards for each criteria pollutant.

OAPCA maintained monitoring stations at Aberdeen and Cosmopolis for purposes of monitoring ambient PM_{10} and SO_2 concentrations through 1995. The monitoring stations were located near the industrialized areas of the county. Because monitored concentrations of both PM_{10} and SO_2 indicated the area was well within attainment of ambient standards, both monitoring stations were discontinued by 1996. Annual emissions of the other criteria air pollutants within Grays Harbor County have not justified an ongoing monitoring effort for these pollutants. As a result, ambient data from Grays Harbor County is only available for PM_{10} and SO_2. Background concentrations for other criteria pollutants are estimated using monitoring data from other locations in Washington determined by OAPCA to be similar from an emission loading perspective. Table B-2-3 below provides a summary of estimated maximum background concentrations for the criteria pollutants of concern as provided by OAPCA.

Table B-2-3
Background Ambient Air Quality for Satsop CT Project Site

Pollutant	Estimated Background Concentration	NAAQS or WAAQS	Averaging Period	Units
PM_{10}	36	150	24 hr	$\mu g/m^3$
	20	50	annual avg	$\mu g/m^3$
SO_2	104	400	1 hr	ppb
	102	500	3 hr	ppb
	31	100	24 hr	ppb
	2	20	annual avg	ppb

Table B-2-3 (Continued)
Background Ambient Air Quality for Satsop CT Project Site

Pollutant	Estimated Background Concentration	NAAQS or WAAQS	Averaging Period	Units
CO	10.4	35	1 hr	ppm
	6.8	9	8 hr	ppm
NO_2	8.8	50	annual avg	ppb

Sources of background data:
PM_{10}(24 hr) background: 2nd highest value from Aberdeen, 1994.
PM_{10} (annual) background: annual arithmetic mean of Aberdeen, 1994.
SO_2 (24hr) background: 2nd highest value from Cosmopolis, 1994.
SO_2 (3hr &24hr) background: maximum values from Cosmopolis, 1994.
SO_2 (annual) background: annual mean from Cosmopolis, 1994.
CO (1hr & 8hr) background: 2nd highest from Lacey, 1997.
NO_2 (annual) background: Chehalis Power EFSEC Application, May 1995.

B-2.2 ENVIRONMENTAL IMPACTS OF PROPOSED PROJECT

Phase II of the Satsop CT Project will be a modification to a major stationary source located in an area that is in attainment for all criteria pollutants. A demonstration that the proposed project is in compliance with applicable federal and state ambient air quality standards, New Source Performance Standards (NSPS), best available control technology (BACT), air toxics standards, opacity, and visibility is required. Please refer to Section 6.1 – PSD Application, of the Application for Amendment 4 to the Site Certification Agreement, WAC 463-42-385, for detailed description of analysis of methodology, calculated concentrations, and air quality impact assessments.

B-2.2.1 New Source Review (NSR)

The Clean Air Act requires that new major stationary sources of air pollution obtain air pollution permits and/or approvals prior to commencing construction. Sources located in attainment areas (areas where all NAAQS have been met) are required to perform new source review (NSR) for compliance with NAAQS and PSD requirements.

NSR regulations require an estimate of a new or modified source's "potential to emit," which is the maximum capacity of a stationary source to emit a pollutant under its physical limitations and operational design. Any physical or operational limitation on the capacity of the source to emit a pollutant, provided the limitation is federally enforceable, is to be treated as part of its design. Table B-2-4 presents the potential to emit estimates for the Satsop CT Project.

Table B-2-4
Maximum Potential to Emit Estimates for Criteria Pollutants

Criteria Pollutant	Power Generation Units (tons/yr)	Auxiliary Boilers (tons/yr)	Diesel Generators (tons/yr)	Cooling Towers (tons/yr)	Total Potential to Emit (tons/yr)
NO_x	580.2	2.6	5.1	--	588
SO_2	22.8	0.1	0.1	--	23
PM[a]	425.7	0.7	0.3	9.02	436
CO	873.4	2.7	6.3	--	883
VOC	193.2	1.2	0.7	--	195[b]

Based on four PGUs, two auxiliary boilers, two diesel generators, and two cooling towers, assuming 8,760 hours with duct firing for each power generation unit, 2,500 hours for each auxiliary boiler, 8,760 hours for each cooling tower, and 500 hours for each diesel generator; includes emissions from the startup and shutdown cycles.
[a] TSP, PM_{10}, and $PM_{2.5}$ conservatively assumed to be equal. Includes ammonium sulfate and bisulfate compounds. Emissions as measured by EPA Reference Method 201/201a and Method 8.
[b] Includes emissions from two diesel fuel oil storage tanks.

To demonstrate compliance with NAAQS and WAAQS requirements, the uncontrolled and controlled emissions of each air pollutant must be quantified for the source. These emissions are calculated for use in air dispersion models which will determine the proposed source's impact on the air quality in the region. Air quality impact assessments (AQIAs) are performed using dispersion modeling techniques in accordance with the EPA's *Guidelines on Air Quality Models* (USEPA 1986). The dispersion models chosen for this air quality analysis were the EPA's SCREEN3, ISC-PRIME, and AERMOD dispersion models. Particulate matter (TSP, PM_{10}, and $PM_{2.5}$), NO_2, CO, and SO_2 were modeled based on time intervals of regulatory concern. There are no background sources within the project's significant impact area; therefore only the Satsop CT Project's modeled concentrations were compared with applicable standards to evaluate the project's impact on ambient air quality. Table B-2-5 summarizes the results from the air quality modeling analysis. All concentrations were below federal and state standards and increments for the listed criteria pollutants.

Table B-2-5
Air Quality Modeling Results
WAAQS and NAAQS

Pollutant	Averaging Period	Maximum Ambient Impact Concentration ($\mu g/m^3$)	National Ambient Air Quality Standards ($\mu g/m^3$)		Washington Ambient Air Quality Standards ($\mu g/m^3$)
			Primary	Secondary	
Total Suspended Particulate Matter (TSP)	Annual	0.91	--	--	60
	24-Hour	4.86	--	--	150
Particulate Matter Less than 10 µm (PM_{10})	Annual	0.91	50	[a]	50
	24-Hour	4.86	150[b]	[a]	150
Particulate Matter Less than 2.5 µm ($PM_{2.5}$)	Annual	0.91	15[k]	[a]	--
	24-Hour	4.86	65[k]	[a]	--
Sulfur Dioxide (SO_2)	Annual	0.29	80	--	52[c]
	24-Hour	1.52	365[b]	--	262[d]
	3-Hour	6.14	--	1,300[b]	[e]
	1-Hour	10.93	--	--	1,048[e]
Nitrogen Dioxide (NO_2)	Annual	0.898	100	[a]	94[h]
Nitrogen Dioxide (NO_2) from SU/SD	Annual	0.16	100	[a]	94[h]
Lead (Pb)	Quarterly	0.00002[j]	1.5	[a]	--
Ozone (O_3)	8-Hour	[g]	157[f][k]	[a]	[i]
	1-Hour	[g]	235[b]	[a]	235
Carbon Monoxide (CO)	8-Hour	122.3	10,000[b]	--	10,000
	1-Hour	504.0	40,000[b]	--	40,000
Carbon Monoxide (CO) from SU/SD	8-Hour	144.1	10,000[b]	--	10,000
	1-Hour	2,754.6	40,000[b]	--	40,000

[a]Same as primary NAAQS.
[b]Concentration not to be exceeded more than once per year.
[c]40 CFR 50.3; Washington standard is 0.02 ppm.
[d]40 CFR 50.3; Washington standard is 0.1 ppm.
[e]No Washington 3-hour standard. Washington 1-hour standards are 0.4 ppm (not to be exceeded more than once per year) and 0.25 ppm (not to be exceeded more than twice in a consecutive 7-day period).
[f]Limited implementation. Three year average of the annual 4th highest daily maximum 8-hour concentration.
[g] Grays Harbor County is designated as an attainment area for ozone.
[h]40 CFR 50.3; Washington standard is 0.05 ppm.
[i]No Standard.
[j]Conservatively based on maximum 1-hour impact concentration.
[k]A 1999 federal court ruling blocked implementation. EPA has requested the U.S. Supreme Court to reconsider the decision.

B-2.2.2 New Source Performance Standards, Acid Rain Provisions, and BACT

NSPSs are nationally uniform emission standards established by EPA and set forth in 40 CFR Part 60. The State of Washington has adopted these standards in WAC 173-400-115. The Satsop CT Project will comply with the NSPS emission limits for NO_x and SO_2 established in 40 CFR Part 60, Subparts Da and GG. Acid rain requirements and standards are contained within Title IV of the Clean Air Act Amendments of 1990. These standards limit potential emissions of NO_x and SO_2 from certain classes of stationary gas turbines and represent the minimum level of control that is required.

B-2.2.2.1 40 CFR Part 60 Subpart Da

Subpart Da applies to electric utility steam generating units with heat input from fuel combustion greater than 250 million British thermal units per hour (MMBtu/hr). When the duct burners are firing, this NSPS would apply as the heat input from each duct burner is approximately 505 MMBtu/hr. Because the duct burners will fire only natural gas, only those sections of this NSPS will apply to the Satsop CT Project.

Subpart Da limits particulate matter emissions to 0.03 lb/MMBtu and SO_2 and NO_x emissions to 0.20 lb/MMBtu. With a firing rate of 505 MMBtu/hr for each duct burner, the NSPS limits become 15 lb/hr for PM and 101 lb/hr for SO_2 and NO_x. The proposed emission rates for each duct burner are 5.5 lb/hr for PM, 0.31 lb/hr for SO_2, and 44 lb/hr NO_x. All proposed emission rates are less than the NSPS limits.

B-2.2.2.2 40 CFR Part 60 Subpart GG

Stationary gas turbines with a heat input from fuel combustion exceeds 100 million BTU/hr, 40 CFR Part 60.332(a)(1) requires that that NO_x concentrations in gaseous discharges from stationary gas turbines do not exceed concentrations calculated as follows:

$$STD = 0.0075\ ((14.4)/y) + F$$

where
STD = allowable NO_x emissions, percent by volume at 15 percent O_2 on a dry basis
y = manufacturer's rated heat rate, kilojoules per watt-hour (kJ/watt-hr)
F = NO_x emission allowance for fuel-bound nitrogen

Using (1) a conservative assumption that there is no fuel-bound nitrogen in the natural gas (as natural gas contains primarily methane, ethane, and propane) and (2) the manufacturer's rated heat rate of 9570 Btu/kw-hr, the allowable emission rate calculated using the above equation is 119 parts per million by volume, dry (ppmvd). The proposed NO_x concentration for each Satsop CT

Project power generation unit (PGU) is 2.5 ppmvd at 15 percent O_2. Consequently, the Satsop CT Project will comply with the NO_x emission standard.

Subpart GG of 40 CFR Part 60.333(a) limits SO_2 emissions to 0.015 percent by volume at 15 percent O_2. This equates to 150 ppmvd and the Satsop CT Project is proposing 0.11 ppm. Consequently, the Satsop CT Project will comply with the SO_2 emission standard.

The project's continuous emissions monitoring system (CEMS) will be designed, operated, and maintained in accordance with 40 CFR Part 60, Appendix B, Performance Specifications 2, 3, and 4. A data acquisitions system will also be used to determine and record compliance with the air quality permits.

As required, continuous emission monitors (CEMs) for the stack exhaust gas will be installed to monitor compliance with the air contaminant discharge rates allowed during operations in the permit. NO_x and O_2 monitors will be used to aid in controlling operations of the SCR and the CT dry low-NO_x combustors.

B-2.2.2.3 Acid Rain Provisions

Title IV of the Clean Air Act Amendments of 1990 requires all facilities with gas turbines rated with an electric output greater than 25 MW that provide at least one-third of the output to a distribution system must comply with the Part 75 regulations. The Satsop CT Project will be required to monitor NO_x, SO_2, O_2, and flow rate. The continuous emission monitors required under the NSPS regulations are similar to those required by Part 75; however, the accuracy limits during the annual relative accuracy test audits are more stringent.

B-2.2.2.4 Best Available Control Technology

Ecology and OAPCA require that BACT be evaluated for the construction of a new source or modification of an existing source. Additionally, as the Satsop CT Project will be a modification to a major source, a BACT determination is required as part of the PSD permit application. A BACT analysis is conducted to ensure that all technically feasible control technologies are evaluated. The BACT evaluation ensures that air pollutant emissions are mitigated while limiting the impacts on available energy, the economy, and the environment within an affected area. This analysis ultimately determines the allowable emissions from a source and is the basis for emission rates, and demonstrating compliance with ambient air impacts and applicable regulations. The application of BACT must result in emissions which comply with the federal, state, and local ambient impact standards. Ecology and OAPCA recommend a "top-down" approach for BACT be used to determine BACT. This approach ranks all feasible and available control technologies in descending order of control effectiveness. The most stringent or "top" alternative is examined first.

This alternative is established as BACT unless the applicant demonstrates to the satisfaction of the permitting authority that due to other considerations such as technical, energy, environmental, or economic reasons, it can be justified that a less stringent control technology is appropriate. If the most stringent technology is eliminated then the process is repeated for the next most stringent alternative and so on.

B-2.2.3 Toxic Air Pollutants

New sources of air toxics are regulated on the state level by WAC 173-460. Under these regulations, emissions of toxic air pollutants (TAPs) from new sources must be evaluated to ensure compliance with WAC 173-460-070. Additionally, new sources must use best available control technology for toxics (T-BACT). T-BACT applies to each TAP or mixture of TAPs that is discharged, taking into account the potency, quantity, and toxicity of each TAP. Under these air toxic regulations, an initial evaluation known as a small quantity emission rate (SQER) analysis is to be performed, and TAPs exceeding the SQER are then required to undergo air dispersion modeling (i.e., an acceptable source impact level [ASIL] analysis). In addition, if a TAP does not have a SQER, it must be modeled.

B-2.2.3.1 Small Quantity Emission Rate (SQER) Analysis

Table B-2-6 presents the estimated TAP emission rates for the Satsop CT Project and compares them to the SQER.

Table B-2-6
Small Quantity Toxic Air Pollutant Emission Rate Comparison

Toxic Air Pollutant	Emission Rate (lb/yr)	SQER (lb/yr)[a]	Dispersion Modeling Req'd?[b]
Acetaldehyde	2,346.14	50	Y
Acrolein	187.37	175	Y
Ammonia	28,2107.19	17,500	Y
Arsenic	3.50	na	Y
Barium	38.48	175	
Benzene	744.57	20	Y
Benzo (a) Pyrene*	0.02	na	Y
Benzo (b) fluoranthene*	0.03	na	Y
Benzo (k) fluoranthene*	0.03	na	Y
Beryllium	0.21	na	Y
Butane	18,366.46	43,748	
Cadmium	19.24	na	Y
Chromium	24.49	na	Y
Cobalt	0.37	175	

Table B-2-6 (Continued)
Small Quantity Toxic Air Pollutant Emission Rate Comparison

Toxic Air Pollutant	Emission Rate (lb/yr)	SQER (lb/yr)[a]	Dispersion Modeling Req'd?[b]
Copper	7.43	175	
Dibenzo (a,h) anthracene*	0.02	na	Y
Dichlorobenzene	20.99	500	
Ethylbenzene	468.41	43,748	
Formaldehyde	42,889.95	20	Y
Indeno (1,2,3-cd) pyrene*	0.03	na	Y
Lead	10.71	na	Y
Manganese	3.32	5,250	
Mercury	2.28	175	
Molybdenum	9.62	1,750	
n-Hexane	15,742.68	22,750	
n-Pentane	22,739.42	43,748	
Naphthalene	43.91	22,750	
Nickel	36.73	0.5	Y
Polyaromatic Hydrocarbons (PAH)[c]	129.87	na	Y
Selenium	0.21	175	
Sulfuric Acid Mist	41,125.46	175	Y
Toluene	3,837.78	43,748	
Vanadium	20.12	175	
Xylenes	1,875.17	43,748	
Zinc	253.63	1,750	

(a) na = not applicable as ASIL is < 0.001 $\mu g/m^3$ or TAP ASIL is not established.
(b) Dispersion modeling required if TAP emissions exceed SQER, TAP ASIL is < 0.001 μg/m
(c) Polyaromatic hydrocarbons (PAH) includes all TAPs labeled with * and chrysene.

B-2.2.3.2 Acceptable Source Impact Level (ASIL) Analysis

An ASIL analysis compares the maximum incremental ambient air impacts for each TAP from the new source with an ASIL. ASILs are compound-specific and are classified into two categories: Class A TAPs are known or probable carcinogens and Class B TAPs are non-carcinogens. If maximum impacts from the source are shown to exceed an ASIL, a second tier analysis is necessary. TAPs which were identified in Table B-2-6 as requiring air dispersion modeling were modeled to estimate the maximum ambient impact. The results of these analyses are presented in Table B-2-7. These data show that all TAP concentrations are below the Washington ASILs.

Table B-2-7
Toxic Air Pollutant
Acceptable Source Impact Level Comparison

Pollutant	Class[a]	Maximum Ambient Impact Concentration ($\mu g/m^3$)	ASIL ($\mu g/m^3$)	Further Analysis Required?
Acetaldehyde	A	0.00214	0.45	N
Acrolein	B	0.0034	0.02	N
Ammonia	B	5.17	100	N
Arsenic	A	0.00001	0.00023	N
Benzene	A	0.00168	0.12	N
Beryllium	A	0.000001	0.00042	N
Cadmium	A	0.00005	0.00056	N
Chromium	A	0.00006	0.000083	N
Formaldehyde	A	0.0638	0.077	N
Sulfuric Acid Mist	B	0.108	3.3	N
Lead	A	0.00002	0.5	N
Nickel	A	0.00009	0.00210	N
PAH[b]	A	0.00028	0.00048	N

[a] Class A TAPs are known or probable carcinogens and Class B TAPs are non-carcinogens.
[b] Polyaromatic Hydrocarbons (PAH) includes all TAPs labeled with * and chrysene

B-2.2.4 Opacity

Washington regulations [WAC 174-400-040 (4)] specify that visible emissions of an air contaminant exceeding 20 percent opacity, for more than 3 minutes in any 1 hour, are prohibited. Project emissions will be significantly lower than 20 percent opacity restriction. Operation of the Satsop CT Project is not expected to cause fugitive dust emissions. However, emissions of regulated pollutants, including fugitive dust may occur from construction activities during the construction period. The primary sources of pollution will be vehicle exhaust and fugitive dust caused by equipment movement and excavation. Incremental vehicular emissions will occur as site workers commute to and from the construction site, but will not represent a significant increase in emissions. Excavation, trenching, backfilling, grading, and similar activities may generate dust during construction of the power plants, pipeline, transmission towers, and associated facilities. When these activities and similar activities are in progress, dry soil in the active construction area will be sprayed with water to minimize fugitive dust emissions. Construction impacts are for a limited term and are not expected to result in significant air quality impacts.

B-2.2.5 Odor

Washington regulations [WAC 174-400-040 (4)] restrict odors from any source that may "unreasonably interfere with any property owner's use and enjoyment of his property." Good operating practice and procedures must be used to reduce odors as deemed reasonable. The only chemical to be used as part of the project operations that has an identified odor detection limit is anhydrous ammonia (detection limit = 17 ppm; Hesketh and Cross 1988.) Any concentrations of anhydrous ammonia resulting from project operations are expected to be well below the detection threshold at the site boundary and therefore not a potential impact on the surrounding environment.

B-2.2.6 Air-Quality-Related Values Assessment

PSD regulations require an assessment of the proposed Satsop CT Project's impact to air-quality-related values (AQRVs) in Class I areas. AQRVs include regional visibility or haze; the effects of primary and secondary pollutants on sensitive plants; the effects of pollutant deposition on soils and receiving water bodies; and other effects associated with secondary aerosol formation. Through the PSD program, the Clean Air Act provides special protection for Class I areas and as the federal land managers for the Class I areas, the National Park Service, and U.S. Forest Service (USFS) have the responsibility of ensuring AQRVs in the Class I areas are not adversely affected.

B-2.2.6.1 AQRVs Modeling Procedures

The CALPUFF modeling system was used to examine potential AQRV impacts from Phase I and Phase II of the proposed Satsop CT Project. EPA, Ecology, and the federal land managers currently recommend the CALPUFF system for long-range transport assessments and for evaluating potential impacts to AQRVs in Class I areas. Features of the CALPUFF modeling system include the ability to consider secondary aerosol formation, gaseous and particle deposition, wet and dry deposition processes, complex three-dimensional wind regimes, and the effects of humidity on regional visibility. The modeling procedures used follow the recommendations of the Interagency Workgroup on Air Quality Modeling (IWAQM) and the Federal Land Managers Air Quality Related Values Workgroup (FLAG).

The 378-kilometer (km) by 414-km modeling domain includes the Olympic Mountains, Cascades Mountains, southern Vancouver Island, western Washington lowlands, portions the Lower Fraser Valley, and northwest Oregon. Olympic National Park is the closest Class I area to the Satsop CT Project and is about 60 km north-northwest of the proposed site. Other Class I areas considered in the modeling analysis include Mt. Rainier National Park, Pasayten Wilderness, Glacier Peak Wilderness, Alpine Lakes Wilderness, Goat Rocks Wilderness, Mt. Adams Wilderness, and the Mt. Hood Wilderness. At the request of the USFS, the analysis also considers impacts to the Mt. Baker Wilderness and the Columbia River Gorge National Scenic Area (CRGNSA). These areas are not subject to special protection under the Clean Air Act and model estimates are provided for information purposes only.

B-2.2.6.2 Model Results

Class I Area Increment Consumption

The effects of emissions from the proposed facility on Class I area increment consumption were assessed by comparing predicted pollutant concentrations to Class I modeling significance levels proposed by the EPA. Concentration predictions for SO_2, NO_x, and PM_{10} were obtained using the CALPUFF modeling system, MM5-driven wind fields, and other techniques outlined above. Additionally, predictions within Mt. Baker Wilderness and the CRGNSA were extracted to provide information to the federal land managers for these Class II areas of interest.

Table B-2-8 displays the highest predicted SO_2, NO_x, and PM_{10} concentrations for the Class I areas, CRGNSA, and the Mt. Baker Wilderness. PM_{10} concentrations include primary PM_{10} emitted by the Satsop CT Project, as well as ammonium sulfate and ammonium nitrate formed downwind of the facility. All predictions are based on a worst-case emission scenario assuming Satsop CT Project sources are operating at 100 percent load with supplemental duct firing.

Table B-2-8
CALPUFF Class I Increment Analysis Results

Area	Maximum Concentration Predictions ($\mu g/m^3$)					
	NO_2	SO_2			PM_{10}	
	Annual	Annual	24-hr	3-hr	Annual	24-hr
Class I						
Mt. Rainier National Park	0.00140	0.00010	0.00172	0.00606	0.00426	0.07583
Goat Rocks Wilderness	0.00073	0.00005	0.00114	0.00446	0.00235	0.04452
Mt. Adams Wilderness	0.00044	0.00004	0.00082	0.00315	0.00218	0.03078
Mt. Hood Wilderness	0.00023	0.00003	0.00079	0.00193	0.00203	0.03984
Olympic National Park	0.00790	0.00034	0.00899	0.03883	0.00905	0.22298
Alpine Lakes Wilderness	0.00160	0.00012	0.00195	0.00354	0.00538	0.09014
Glacier Peak Wilderness	0.00095	0.00006	0.00076	0.00242	0.00290	0.03745
North Cascades National Park	0.00065	0.00004	0.00073	0.00212	0.00156	0.03153
Pasayten Wilderness	0.00033	0.00002	0.00034	0.00098	0.00066	0.01401
EPA Proposed Class I SIL	0.10	0.10	0.20	1.00	0.20	0.30
FLM Proposed Class I SIL	0.03	0.03	0.07	0.48	0.08	0.27

Table B-2-8 (Continued)
CALPUFF Class I Increment Analysis Results

Area	Maximum Concentration Predictions (μg/m^3)					
	NO_2	SO_2			PM_{10}	
	Annual	Annual	24-hr	3-hr	Annual	24-hr
Class II Area of Interest						
CRGNSA (All Areas)	0.00092	0.00009	0.00132	0.00475	0.00463	0.05905
Mt. Baker Wilderness	0.00104	0.00006	0.00095	0.00335	0.00239	0.05224
EPA Class II Significance Level	1.00	1.00	5.00	25.00	1.00	5.00

Note: All NO_x conservatively assumed to be converted to NO_2. PM_{10} concentrations include sulfates and nitrates. Emissions based on continuous operation with supplemental duct firing.

The highest model concentration predictions within the study domain typically occur on the elevated terrain several kilometers east of the site in an area known as the Black Hills. These elevated receptors are downwind for the prevailing westerly winds at the site and are also occasionally impacted during light wind conditions. Under westerly winds, the Satsop CT Project plumes once past the Black Hills typically are advected north into Puget Sound.

Table B-2-8 lists EPA's proposed significant impact levels for Class I areas. When predicted concentrations are less than the Class I area significant impact levels, pollutant impacts are considered insignificant, and a comprehensive Class I increment analysis is not required for a given pollutant. However, these levels of significance have not, at this time, been adopted and federal land managers have recommended significant impact levels that are more restrictive than those proposed by the EPA. The federal land manager-recommended levels are also presented in Table B-2-8. All maximum predictions are lower than both the EPA and federal land managers proposed criteria. While these are not adopted regulatory criteria, they are used here to provide a measure of assurance that the Satsop CT Project contributions predicted by the model are not significant.

Pollutant Concentrations Effects on Plants

The federal land managers have the responsibility of ensuring AQRVs in the Class I areas are not adversely affected, regardless of whether the Class I increments are maintained. In order to protect plant species, the USFS recommends maximum SO_2 concentrations not exceed 40 to 50 ppb (105 to 130 μg/m^3), and annual SO_2 concentrations should not exceed 8 to 12 ppb (21 to 31 μg/m^3). Lichens and bryophytes are found in the subalpine and alpine regions of several of the Class I areas. Some of these species may be sensitive to SO_2 concentrations in the range of 5 to 15 parts per billion (ppb) (13 to 39 μg/m^3). The USFS also indicates that no significant amount of injury to plants species in the Pacific Northwest are expected for annual NO_2 concentrations less than 15 ppb (28 μg/m^3). The 24-hour maximum and annual predictions displayed in Table B-2-8 are several orders of magnitude less than USFS criteria established to protect vegetation in Pacific Northwest Class I areas.

Nitrogen and Sulfur Deposition

The CALPUFF modeling system was used to estimate the Satsop CT Project's potential contribution to total nitrogen and sulfur deposition in the Class I areas. Soils, vegetation, and aquatic resources in Class I areas are potentially influenced by nitrogen and sulfur deposition.

Predicted annual nitrogen and sulfur deposition patterns are similar, with the highest deposition predicted near the site, on the Black Hills, and in southern Puget Sound. Wet deposition plays an important role in both nitrogen and sulfur deposition from the proposed project. Wet deposition dominates north of the facility, especially in the mountain areas. Dry deposition is more important south of the site, and for nitrogen, along the western foothills of the Olympic Mountains. Annual sulfur deposition is dominated by the meteorology that accompanies rainfall and removal of SO_2 from the plume. Total nitrogen deposition depends primarily on dry deposition of NO_x and wet deposition of nitrate.

Maximum annual deposition fluxes predicted by the CALPUFF modeling system are presented in Table B-2-9 for each Class I area, CRGNSA, and the Mt. Baker Wilderness. The highest predicted deposition fluxes and changes to existing deposition are in the southeastern corner of the Olympic National Park. However, the deposition fluxes predicted are many times lower than the USFS criteria and existing background levels. Although existing background levels may be of concern, the CALPUFF modeling analysis predicts the proposed project will not significantly add to nitrogen or sulfur deposition in the Class I areas.

Table B-2-9
CALPUFF Annual Deposition Analysis Results

Area	Total Annual Wet Plus Dry Deposition							
	Nitrogen Deposition (kg/ha/yr)				Sulfur Deposition (kg/ha/yr)			
	SCTP	Back	Total	Change	SCTP	Back	Total	Change
Class I								
Mt. Rainier National Park	0.0011	2.40	2.4011	0.0440%	0.0002	3.10	3.1002	0.0054%
Goat Rocks Wilderness	0.0006	9.00	9.0006	0.0063%	0.0001	11.80	11.8001	0.0007%
Mt. Adams Wilderness	0.0004	9.00	9.0004	0.0042%	0.0001	10.80	10.8001	0.0005%
Mt. Hood Wilderness	0.0003	5.40	5.4003	0.0047%	0.0000	8.60	8.6000	0.0004%
Olympic National Park	0.0051	2.00	2.0051	0.2559%	0.0015	5.60	5.6015	0.0268%
Alpine Lakes Wilderness	0.0020	5.20	5.2020	0.0381%	0.0003	7.20	7.2003	0.0042%

Table B-2-9 (Continued)
CALPUFF Annual Deposition Analysis Results

Area	Total Annual Wet Plus Dry Deposition							
	Nitrogen Deposition (kg/ha/yr)				Sulfur Deposition (kg/ha/yr)			
	SCTP	Back	Total	Change	SCTP	Back	Total	Change
Glacier Peak Wilderness	0.0015	5.80	5.8015	0.0257%	0.0002	8.00	8.0002	0.0028%
North Cascades National Park	0.0012	4.00	4.0012	0.0308%	0.0002	3.50	3.5002	0.0056%
Pasayten Wilderness	0.0005	5.20	5.2005	0.0098%	0.0001	7.20	7.2001	0.0010%
USFS Level of Concern			5.0				3.0	
Class II Area of Interest								
CRGNSA (All Areas)	0.0005	9.00	9.0005	0.0055%	0.0001	10.80	10.8001	0.0007%
Mt. Baker Wilderness	0.0018	5.80	5.8018	0.0306%	0.0003	8.00	8.0003	0.0040%

Notes:
Emissions based on continuous 100 percent load operation with supplemental duct firing.
Nitrogen deposition includes ammonium ion.

Regional Haze

The CALPUFF modeling system using the MM5 initialized wind fields were used to calculate 24-hour average extinction coefficients for each day of the year. For all seasons, the highest extinction coefficients are predicted relatively close to the Satsop CT Project in the Black Hills, east of the proposed site. The higher extinction coefficients close to the site are primarily driven by the PM_{10} fraction of the emissions, with hygroscopic aerosols becoming more important further downwind.

Maximum extinction coefficient contours in all seasons follow the lowlands. Conditions conducive to aerosol formation and relatively high concentrations of fine particles are light winds, high relative humidity, and fair weather. During these conditions, high pressure and subsidence inversions are sometimes present to restrict the vertical movement of fine particles. Aerosols remain trapped until a precipitation event removes them or until winds increase sufficiently to allow vertical mixing and transport out of the lowlands.

The episodes affecting the Olympic National Park occur on a day with southerly flow. During these episodes the highest changes to extinction in the Park are predicted in the lower elevations as the Satsop CT Project's plumes are diverted around the mountainous areas. The episodes affecting the Mt. Rainier National Park and Alpine Lakes Wilderness occur during days with high humidity as the Satsop CT Project's plumes enter the lower elevations of these areas.

Table B-2-10 displays the maximum predicted change in 24-hour extinction coefficient for each Class I area, CRGNSA, and Mt. Baker Wilderness. Changes to extinction are based on seasonal background data for good visibility days and are adjusted with hourly humidity using the techniques described above. The extinction budgets for the higher episodes in most Class I areas are influenced by nitrates, PM_{10}, and to a lesser extent sulfates. Sulfates did contribute significantly to the extinction budget for the October 29-30, 1998, 2-day episode affecting the nearby Olympic National Park. With the exception of three days, predicted changes to extinction are less than the 5 percent criterion suggested by the FLMs and Ecology for all seasons and Class I areas. According to this criterion, changes to visual conditions in the Class I areas would usually not be perceptible even when the four Satsop CT Project's PGUs and two auxiliary boilers are emitting at their short-term peak rates.

Table B-2-10
CALPUFF Regional Haze Analysis Results

Area	Maximum Change to 24-hour Background Extinction								
	Date	Bext (1/Mm)			Del Bext (%)	F(RH)	Bext by Component (1/Mm)		
		SCTP	Back	Total			$bxSO_4$	$bxNO_3$	bxPMF
Class I									
Mt. Rainier National Park	09/24/98	1.181	18.49	19.67	6.39	10.30	0.123	0.846	0.213
Goat Rocks Wilderness	09/25/98	0.213	16.45	16.66	1.29	2.71	0.014	0.081	0.118
Mt. Adams Wilderness	09/24/98	0.200	20.78	20.98	0.96	7.37	0.021	0.121	0.058
Mt. Hood Wilderness	07/02/98	0.288	24.71	24.99	1.17	4.03	0.022	0.147	0.119
Olympic National Park	10/29/98	1.673	22.17	23.85	7.55	8.86	0.222	0.705	0.746
	10/30/98	1.298	25.29	26.58	5.13	12.21	0.202	0.591	0.504
Alpine Lakes Wilderness	05/08/98	1.203	27.11	28.32	4.44	14.78	0.125	0.814	0.265
Glacier Peak Wilderness	05/08/98	0.428	30.82	31.25	1.39	14.78	0.043	0.302	0.083
North Cascades National Park	01/05/99	0.271	19.11	19.38	1.42	8.12	0.021	0.181	0.069
Pasayten Wilderness	01/05/99	0.127	19.29	19.42	0.66	8.35	0.010	0.087	0.030
Class II Area of Interest									
CRGNSA (All Areas)	04/23/98	0.547	29.01	29.55	1.89	8.25	0.050	0.365	0.133
Mt. Baker Wilderness	01/05/99	0.694	21.52	22.21	3.23	11.36	0.061	0.484	0.149

Notes:
Emissions are based on continuous operation with supplemental duct firing.
Background extinction derived from aerosol data on days with the best visibility (top 5 percent).

Emissions from combined Phase I and Phase II of the Satsop CT Project are predicted to change background extinction by more than 5 percent on 2 days in Olympic National Park and 1 day in Mt. Rainier National Park. Note, this analysis did not consider whether meteorological conditions causing the greatest impacts actually coincide with good "natural" background visibility. Background aerosol concentrations will likely be higher and fog, low clouds, precipitation and other obscuring weather phenomena may reduce visual ranges so in some instances the impacts of the sources considered in this analysis would not be perceptible.

B-2.2.7 Carbon Dioxide and Water Vapor

B-2.2.7.1 Carbon Dioxide

Carbon dioxide (CO_2) is a by-product of efficient combustion processes. It is also considered to be a factor in global warming. Deforestation, fossil-fueled power plants, and transportation are the primary sources of carbon dioxide emissions. Table B-2-11 presents a compilation of carbon dioxide emitters in Washington state.

The Satsop CT Project has the potential to emit carbon dioxide from the power generation units, auxiliary boilers, and backup diesel generators as follows:

- 1.2 million tons of CO_2 per year from each power generation unit (8,760 hours of operation with duct firing)
- 4,284 tons of CO_2 per year from each auxiliary boiler (2,500 hours of operation)
- 214 tons of CO_2 per year from each diesel generator (500 hours of operation)

Table B-2-11
Washington CO_2 Emission Inventories from Fossil Fuel Combustion (MMTCE)

	1990	1991	1992	1993	1994	1995	1996	1997
Commercial	0.88	0.88	0.72	0.80	0.78	0.81	0.85	0.84
Electric Utilities	2.02	2.12	2.65	2.42	2.61	1.72	2.33	2.00
Distillate Fuel	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Bituminous Coal and Lignite	2.01	2.11	2.56	2.34	2.57	1.62	2.22	1.95
Residual Fuel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Petroleum Coke	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Anthracite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Gas	0.00	0.00	0.08	0.07	0.04	0.10	0.10	0.04
Industrial	4.76	4.41	5.10	4.70	5.23	5.27	5.43	5.24
Residential	1.00	1.05	0.93	1.05	1.05	1.06	1.20	1.19
Transportation	11.26	11.37	12.67	11.54	11.85	12.44	12.11	12.42
TOTAL	19.91	19.82	22.06	20.50	21.54	21.31	21.92	21.69

Table B-2-11 (Continued)
Washington CO_2 Emission Inventories from Fossil Fuel Combustion (MMTCE)

Notes:
This table provides state carbon dioxide emission inventories from fossil fuel combustion that were developed by EPA, using (1) fuel consumption data from the DOE/EIA State Energy Data Report (SEDR) and (2) emission factors from Chapter 1 of the *Emissions Inventory Improvement Program, Volume VIII: Estimating Greenhouse Gas Emissions*. The inventories present annual emissions of CO2 by sector (e.g., industry, transportation, etc.) and by fuel type (e.g., distillate fuel, natural gas, etc.). State totals are reported in million metric tons of carbon equivalent (MMTCE).

These CO2 emissions were calculated using fuel consumption data from the Combined State Energy Data System (CSEDS). The most recently published data from the CSEDS can be found in *State Energy Data Report 1997* DOE/EIA-0214(97). The report and the spreadsheets containing the background fuel consumption data may be found on the Energy Information Administration's Website.

Source:
http://yosemite.epa.gov/globalwarming/ghg.nsf/emissions/CO2EmissionsBasedOnStateEnergyData?OpenDocument&Start=30&Count=30&Expand=48.2

B-2.2.7.2 Water Vapor

The Satsop CT project will have several sources of water vapor emissions. These sources include:

- Moisture in the natural gas that is combusted, moisture in the aqueous ammonia that is used to control nitrogen oxides, and moisture in the combustion air. These sources of moisture result in water vapor that is emitted from the Heat Recovery Steam Generator (HRSG) stacks of the facility.
- Water vapor is emitted from the combustion of natural gas in the auxiliary boilers and emergency backup diesel generators.
- Water vapor is emitted from the cooling towers. While the cooling towers utilize drift eliminators to restrict drift droplets, a water vapor plume will be present at times. Typically the plume can range in size up to 40 to 50 meters in length.

The water vapor emitted through any of these sources poses no adverse impact to the environment, nor to human health.

Most water will be emitted when the plant is operated at full load with all duct burners fired. The emissions from the three sources listed above will be:

- HRSG exhaust stack: 238,000 lb/hr or 118 tons/hr
- Auxiliary boiler water vapor emissions: 3,100 lb/hr or 1.5 tons/hr
- Cooling tower water vapor emissions: 1,624,000 lb/hr or 812 tons/hr, and cooling tower drift droplets: 4,000 lb/hr

Minimal to no water vapor emissions are expected from the diesel generators as these are used only on an emergency basis (less than 500 hours per year each).

Some particulate matter will be emitted in the cooling tower drift droplets, at a rate of 1.03 lbs/hr per cooling tower (4.51 tons per year per cooling tower). These particulate emissions were included and analyzed in the permit application, and are included in the total particulate matter emissions reflected in the permit conditions.

B-2.2.8 Dust

Dust generated by construction activities will be short term. Dust from these activities will be controlled by applying gravel or paving to the access road. Water will be applied as necessary.

B-2.3 MITIGATION MEASURES

The following mitigation measures will be employed:

- To control dust during construction, water will be applied as necessary, and access roads will be graveled or paved.
- To reduce air pollutant emissions from the PGUs, auxiliary boilers, backup diesel generators, and cooling towers, Best Available Control Technology will be utilized at the Satsop CT Project.
- Mitigation of potential impacts to air quality will be accomplished with the use of best available control technology (BACT). Proposed BACT for pollutants associated with the proposed project are shown in Table B-2-12. Project emissions to the atmosphere will be in compliance with applicable state and federal regulations.

- The Certificate Holder will maintain and operate equipment in accordance with vendor recommendations and generally accepted practices in order to prevent excessive emissions and minimize fuel consumption.

- To control dust during construction, water will be applied as necessary, and access roads will be graveled or paved.

Table B-2-12
Proposed Air Pollution Control Technologies

Pollutant	Proposed BACT
NO_x	Power Generation Units: Dry Low-NO_x combustor Selective catalytic reduction (SCR) Natural gas firing only
	Auxiliary Boilers: Flue gas recirculation Low-NOx burners
	Emergency Backup Diesel Generators: Turbocharging/aftercooling Variable fuel injection timing retard
CO	Power Generation Units: Catalytic Oxidation
SO_2	Power Generation Units: Natural gas firing only
	Emergency Backup Diesel Generators: Limited fuel oil use Low sulfur fuel
VOC	Power Generation Units: Proper combustion Turbine design (additional reduction due to CO Catalyst)
PM_{10}	Power Generation Units: Proper combustion Natural gas firing only
	Emergency Backup Diesel Generators: Limited fuel oil use Low sulfur fuel
	Cooling Towers: Two-stage, low-drift eliminators
Ammonia	Power Generation Units: Proper combustion Adequate mixing

Table B-2-12 (Continued)
Proposed Air Pollution Control Technologies

Pollutant	Proposed BACT
Other toxics	Power Generation Units: Proper combustion
	Auxiliary Boilers: Proper combustion
	Emergency Backup Diesel Generators: Limited fuel oil use

B-2.4 SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

As discussed earlier, emissions from combined Phase I and Phase II of the Satsop CT Project are predicted to change background extinction values by more than 5 percent on 2 days in Olympic National Park and 1 day in Mt. Rainier National Park. While the change in background extinction is greater than the 5 percent threshold for significance, the predicted maximum change in background extinction is less than the 10 percent exceedance level used by EPA and the FLMs to judge the severity of the impact, and again, will only occur for 1 to 2 days. Additionally, the analysis did not consider whether meteorological conditions causing the greatest impacts actually coincide with good "natural" background visibility. Background aerosol concentrations will likely be higher and fog, low clouds, precipitation and other obscuring weather phenomena may reduce visual ranges so in some instances the impacts of the sources considered in this analysis would not be perceptible

No other significant impacts are predicted.

Figure B-2-1
Wind Frequency Distribution for Satsop CT Project Site